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REPORT ON THE APPLICATION OF COPYRIGHT ON COMPUTER USAGE

National Academy of Sciences--National Research Council
Washington, D.C.

1 December 1967

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REPORT

ON

THE APPLICATION OF COPYRIGHT ON COMPUTER USAGE

NATIONAL ACADEMY OF SCIENCES
WASHINGTON, D.C.

December 1, 1967

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I. SUMMARY OF MAIN FINDINGS

It is the general opinion and finding of the panel that:

1. Computer information processing is of growing importance, and in a multitude of ways involves dealing with what is copyrightable material.

2. The copyright revision bill does not deal directly with many vital aspects of computer information processing. We feel that enacting it into law in its current form could lead to difficulties of interpretation.

3. We recommend further study of the copyright issue, and support in general the proposal to create a study commission on copyright law. We find that the Panel is divided on the advisability of enacting the present bill in its current form, pending the outcome of the Commission's study.

In the body of this report, a general discussion is presented which gives in more detail the background information upon which these findings are based. A final section deals with a number of specific problems which we foresee could result from the passage of this bill.

II. GENERAL DISCUSSION

1. Computers are a New and Growing Business

The importance of computers to the activities of the scientific and technical community, and the great size and astonishing growth rate of the computer industry make it essential to consider carefully any legislation which might affect the constructive contribution of computers to the progress of science and technology. There are now more than 28,000 computers in the United States, and the electronic data processing and computer industry is valued at $6 billion, and has a growth rate of 20% per year.[*]) Industry, governmental agencies, educational institutions, and other organizations in both the public and private sector use computers in a variety of ways. They can be used to improve many different kinds of operations by adding new capabilities and by performing routine tasks more efficiently. In the scientific area they can be used to perform calculations which are impossible to do by hand and to analyze large quantities of data with great speed and efficiency. We can confidently predict that the computing area will continue to grow in importance, not only to the scientific and technical community, but also to society at large. While its present importance is great, its importance in the future will be even greater. Impending legislation which may affect computers and their usage should be carefully considered to make sure that the effect will be to stimulate growth and encourage experimentation.

Before discussion other aspects of computers, we must establish what we mean by the term "computers". The term can be construed, and is frequently used, in the narrow sense of a central electronic processor. Such a device, when operated in conjunction with ancillary equipment, is capable of receiving information, manipulating it, and putting out processed data. However, in this report, we shall use the term "computers" to mean:

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[*] "Thinking Big." Barron Report, October 2, 1967, p. 3 and following.

> The complex of newly available technology by means of which information can be processed and communicated in a variety of ways with great speed, can be stored for future use, displayed in both ephemeral and permanent forms, and can be reproduced at nearby or remote locations.

It is very clear that in this broad sense the computer is having, and in the future will have, an even stronger impact on traditional means of disseminating information to the scientific and technical community, as well as other segments of our society.

The computer is a new development; before World War II capabilities of this type did not exist. Therefore, its effect on traditional means of information dissemination is only beginning to be felt. But as new applications are developed, it is safe to assume that its impact will be a permanent one and that some of our current methods of disseminating information will become obsolete.

2. The Use of Computers Involves "Copyrightable" Materials

Computers can make use of materials that are "copyrightable" in the traditional sense.

The first use of computers was to replace the desk calculator, and the programs that were used to generate the solution of the problems were not of a nature that had been traditionally copyrightable. The computer basically expressed solutions to problems in a form which could be interpreted as a translation into machine language of a method of solution that was either already known, or would be obvious to experts in the field.

Subsequently computers were used in a way more analogous to a special-purpose device: for example, in process control. Here the computer program residing in the machine may be a replacement for, or a simulation of, electrical circuits that could have been specially constructed. Some such programs may have the originality and inventive character that would make them analogous to new devices—devices which would normally be considered for patent protection. It may not be possible to make a general statement about which of these programs should—and which ones should not—be afforded such protection, just as it is not possible to make a general statement about which device should be patented.

A third utilization of computers is the manipulation of textural materials: for example, basic files of physical data of the type accumulated in handbooks, tables of mathematical functions similar to those occurring in handbooks of mathematical tables, teaching programs aimed at providing instruction at various levels, etc. Here the materials contained in and disseminated by the computer are quite similar to those contained in elementary textbooks. It is possible for computers to transform and edit material, such as music, or to derive concordances of literary materials. There are in existence computer programs which generate music, which write poetry, and which draw cartoons. Most of these programs are on a highly experimental basis at the present time, but it is not unlikely that practical and widespread uses will be made of such programs in the not too distant future. Those programs which instruct the computer to create the music or to draw the cartoons might be programs which would have been provided patent protection in the traditional sense; and the result of applying these programs is to produce music, poetry, or cartoons which are normally copyrighted.

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In summary, therefore, it appears that computers may take in copyrightable materials as input for processing. They may generate material as their output which is copyrightable, and in some cases the programs that control the machine may be copyrightable, or entitled to some other kind of protection.

3. Computer Usage can be Expected to Grow Rapidly

The use of computers in all facets of contemporary life has grown at an explosive rate, and we can expect this growth to continue far into the future. This utilization of computers has been likened to the industrial revolution, and properly so. The computer is a new tool, a symbol-manipulating tool whose full capabilities are not yet known.

One of the factors that distinguish man from beast is his ability to abstract and to symbolize. Man has learned to represent many of his ideas in terms of symbols. Mathematics has given us the capability of deriving relationships between symbols and carrying out transformations on these symbols. The printing press was a means of recording and transmitting man's symbols. The computer provides a tool for manipulating or rearranging and transforming the symbols. The hand axe was perhaps man's first mechanical tool, and the invention of the lever in the form of a handle on the hand axe gave great manipulative power to this tool and led to subsequent inventions of more complex tools. One might compare the printing press with the hand axe, and the computer to the lever. Figuratively speaking, the computer has put a handle on our symbol manipulating capability.

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Computers are now a powerful aid in solving engineering, physics and mathematical problems; and more powerful methods are being discovered every day which will lead to greater uses in solving scientific problems. The use of a computer as a simulator of other devices is growing. The equations which govern the control of a process can be programmed in a computer and the computer then becomes a process-control device. A computer is, of course, a superb handler of information, and can provide many of the facilities of a library. Utilization of machines for storage and retrieval, and for searching of data, will certainly increase manyfold. As we solve more and more of the problems of man-machine communication, the computer will become a powerful tool in teaching, scheduling, report writing, editing, and other simple clerical functions.

New uses for computers are being uncovered rapidly, and new methods are being developed that will permit exploitation of the computer in completely new areas. It is apparent that the future of computers and their usage cannot be predicted with any certainty—except for the positive statement that so far we have only explored a small fraction of the vast number of possibilities.

4. Computers are Used by All Sections of Society

Computer technology has found application in many phases of our life. Computers are used by many different organizations—large and small, private and public. They are used to solve mathematical problems of an abstract nature. They are used to solve engineering problems for very specific uses. They are used to analyze data, to accumulate and store information, to disseminate data and information, and as aids to teaching.

In these various forms, computers are of great value to governmental operations (both scientific and administrative); and in private business they are used to improve efficiency and overall productivity.

There is little doubt that the advent of the computer age has had enormous beneficial effects upon society. But even more important is the fact that these uses can be expected to multiply in the future. If we are to achieve the optimum use of computers, it is important that their growth be encouraged.

The computer is being applied to tasks of ever greater complexity and importance in our society—management information systems, scientific and technical information retrieval, governmental data banks, military command and control, etc. Unfortunately, the present knowledge about the problems in applying the computer to such applications is almost nonexistent. Extensive experimentation with the computer is, therefore, particularly important to ensure that the computer is indeed used to the best advantage of society. Such experimentation should be encouraged.

5. Computer Coverage under the Proposed Copyright Legislation

Under the proposed copyright revision bill, computer usage will basically be covered by general provisions restating conventional concepts of copyright law. The bill does not include provisions specifically written with the computer in mind.

We believe that this subject deserves the most careful consideration so that legislation can be enacted which will have a constructive effect on this most important matter.

6. The Proposed National Study Commission on Copyright

In our opinion, the copyright problems raised by the computer are so novel and complex that the technical and scientific communities would benefit from an intensive study by a governmental body specially designated for the purpose.

Accordingly, we support the idea of the recent proposal to establish a National Study Commission

III. SPECIFIC PROBLEMS

Several potential problem areas were brought into focus during the discussions of our Panel. For illustrative purposes, several of these are described in more detail below in order to suggest the possible impact of the bill. Discussion is limited to the problems that are associated with computers and related technologies.

Because the subsequent legal interpretation of the proposed bill will depend not only on the language of the bill itself, but also on the spirit and intent of the legislation as expressed in the records of the committee hearings and reports, this report makes reference to the background reports. The main sources used in this study are:

S. 597	U.S. Congress. Senate. A bill for the general revision of the Copyright Law, title 17 of the United States Code, and for other purposes. S. 597. 90th Congress, 1st session. Jan. 23, 1967. Introduced by Sen. McClellan.
H.R. 2512	U.S. Congress. House of Representatives. A bill for the general revision of the Copyright Law, title 17 of the United States Code, and other purposes. Passed by House of Representatives April 11, 1967.
H. Rept. 2237	U.S. Congress. House. Committee on the Judiciary. Copyright Law Revision. 89th Congress, 2nd session. House Report No. 2237, Oct. 12, 1966. Submitted by Mr. Kastenmeier.
H. Rept. 83	U.S. Congress. House. Committee on the Judiciary. Copyright Law Revision. 90th Congress, 1st session. March 8, 1967. Submitted by Mr. Kastenmeier.

Copyright Law Revision Part 6	U.S. Congress. House. Committee on the Judiciary. Copyright Law Revision Part 6, Supplementary Report of the Register of Copyrights on the General Revision of the U.S. Copyright Law: 1965 Revision Bill; report to accompany HR. 4347 and S. 1006. 89th Congress. 1st session, May 1965.

These reports are cited in their brief form in the discussions that follow.

1. The Question of According Copyright to Computer Programs

The production of computer programs in this country currently is estimated to involve an expenditure of over a billion dollars per year. By 1970, an estimated one-half million people will be employed in programming activities. (Ref. Barron's article cited earlier). Many of the completed programs have been made freely available for others to use by such means as publication in technical journals, reports, and instructional manuals; by information distribution; and by distribution through organized clearinghouses of program information (e.g., SHARE) established by the many users of computer equipment. For many types of programs the authors (personal and corporate) are interested in making the programs available for all parties to study and use.

In contrast, there are many programs that are closely controlled as proprietary investments or trade secrets. One example would be an extremely efficient file sorting program written by a computer service bureau that would enable its customers to sort their files in half the time and cost required at another service bureau. There could definitely be lost revenue for the firm that wrote this program if a competitor could freely obtain and use the same program. Another example would be the program written by an oil company for the computer control of a petrochemical refinery at a considerable improvement in efficiency and cost over prior methods of control. This oil company would lose some competitive edge if the program were made available to a competing oil company.

Protection might also be sought for programs because they contained some key elements of information such as stock market or election prediction rules, or ingredients and control for the manufacture of proprietary products (e.g., soft drinks or camera film emulsions) or because they contained large amounts of useful reference information that might otherwise be used without compensation for the developer (e.g., Dun and Bradstreet statistical and financial data for 100,000 major U.S. companies).

There appears to be considerable disagreement, both within the industry and between the users, on the question of whether programs should be protected. One of the reasons for the disagreement is that there are so many facets of the use of the developments for computers that very few people can look at all aspects. There is also disagreement regarding the form of protection that might be provided (patent, copyright, other new form).

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In May 1964, the Copyright Office agreed to accept programs for copyright registration under the existing legislation*) if the programs constitute works of original authorship. The Copyright Office made it clear that this policy does not mean that all or any programs are copyrightable. Those questions must be resolved by the courts.

The proposed bill is broad enough to cover computer programs in some sense. Thus Section 102 (S.597 and HR.2237) includes among "original works of authorship" capable of copyright, "literary works," and these are further defined by Section 101 as "works expressed in words, numbers, or other verbal or numerical symbols or indicia, regardless of the nature of the material objects, such as books, periodicals, manuscripts, phonorecords, or films, in which they are embodied." The Report of the Register of Copyrights (RC pt. 6, p. 67) says, "The definition of literary works . . . is broad enough to cover every possible form of verbal or numerical expression including, for example, computer programs fixed on punch cards, magnetic tape, or any other media."

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*Copyright Office Circular 31D, January, 1965.

But there are a number of remaining questions. What kinds of programs would be covered? As programming languages become more machine-independent and general in form, syntax, and vocabulary, we will reach the point where programs approach statements of general concept. What kind of protection can be given to a program when it is written as a general statement or approach?

What would be the effect of the availability of copyright on the publication of programs in books, journals, and other sources, and on the use of programs so published? Some observers think that if it were possible to copyright simple mathematical routines, scientific problem-solving could be seriously hampered, and scientific uses of computers curtailed. On the other hand, copyright would provide some form of protection for organizations whose programs represent considerable investments and make possible systems of program leasing and selling. In this way, one can argue that scientific problem solving would benefit from the availability of copyright.

The advent of copyrighted programs may cause administrative difficulties for computer centers as they must determine, and later keep track of, which items in their program library are copyrighted and require special handling. Such centers might also be put in the position of having to check each user's intended application to see whether or not he was a legitimate exempt user. This, however, is hardly a serious criticism because one of the principal advantages of a computer is its ability to handle problems of a bookkeeping nature.

2. The Question of the Reach of a Copyright on Computer Programs: Would it Cover the Plan, Concept, Theorem, Process, etc.?

There are instances in which the first appearance of a new technique may be in a specific computer program. This technique may represent a novel work or invention. It may be:

- of a mathematical nature (e.g., a new method to solve a particular type of equation), or
- of a linguistic nature (e.g., a new method to perform machine language translation), or
- logical (e.g., a method of computer internal control that replaces a hardware circuit with a programmed equivalent or virtual circuit), or
- other non-mathematical nature (e.g., a new method to sort records into alphabetic sequence).

The developers of such programs can justifiably argue that their contribution should be rewarded with some form of copyright or limited monopoly.

In some instances the number of methods for solving a particular problem may be relatively small; e.g., computing the area of a circle or converting binary to decimal numbers. Under such circumstances other programmers might develop identical or similar programs even though they had never seen the original. This might be awkward because it would place a burden upon the second programmer to prove that his work was original with him and was not copied from the first programmer. It is possible that in order to avoid this kind of dilemma later, programmers might choose to carry out their work in more clumsy ways rather than to risk disproof of a charge of copying.

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There appears to be some confusion as to whether or not the copyright for a computer-operator process would cover the process itself, as well as the program of the computer. Actually it would cover neither, but merely the expression of the program or of the ideas or information on which it is based. To extend protection to processes would be contrary to copyright tradition, and raises questions as to the relationship of copyright to patent protection. It should be noted that in this case protection would run for about 75 years, in contrast to the 17 years of the present patent law.

The President's Commission on the Patent System recently advised against the patenting of computer programs, saying ". . . a 'program' shall not be considered patentable."*) However, the stated basis for the recommendation was the practical fact that reliable patent searches would not be feasible or economic because of the tremendous volume of prior art being generated, and without this search the patenting of programs would be tantamount to mere registration.

3. The Question of Input Copying in a Machine-Language Representation

Every program and method of computer processing requires that the data to be processed must be first converted to a machine-language representation before they can be processed. The data cannot be handled by the computer unless they can first be sensed by such means as character recognition devices, punched paper tape or card readers, or magnetic record readers. There are innumerable cases where it will be necessary or desirable to convert copyrighted material into machine-readable form for subsequent processing by the computer.

Where is the proper point of control for such uses? Should copyright protection apply at the point of input—the point where the copyright material

*Report of the President's Patent Commission, Senate Document No. 5, 90th Congress, 1st Session, 1967.

is converted into machine-readable form, or would it be more desirable to apply controls at the output of the computer—the point where the copyrighted material is put to some human use?

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There are two strong schools of thought on this issue. The proponents of "input" control believe that this is the only possible point at which protection can be guaranteed because once the information is in the computer, many people will have access to it for any purpose. The proponents of "output" control believe that copyright protection should apply only to the ultimate use of the information, thereby encouraging experimentation on the whole subject of information storage, retrieval and use.

This problem is further complicated by the concepts of "fair use" and exemptions.

Section 106 says that ". . . the owner of copyright . . . has the exclusive [right] . . . (1) to reproduce the copyrighted work in copies or phonorecords; . . . ."

HR.83 states that, "Under the bill it makes no difference what the form, manner, or medium of fixation may be—whether it is in words, numbers, notes, sounds, pictures, or any other graphic or symbolic indicia, whether embodied in a physical object in written, printed, photographic, sculptural, punched, magnetic or any other stable form, and whether it is capable of perception directly or by means of any machine or device 'now known or later developed'." (p. 15). And further, ". . . unless the doctrine of fair use were applicable, the following computer uses could be infringements of copyright under section 106: reproduction of a work (or a substantial part of it) in any tangible form (paper, punch cards, magnetic tape, etc.) for input into an information storage and retrieval system; reproduction of a work or substantial part of it, in copies as the 'print-out' or output of the computer; . . . ." (p. 25).

HR.83 provides arguments on both sides of the question of copyright protection on computer input, and makes the summary statement, ". . . section 106 preserves the exclusive right of the copyright owner with respect to reproductions of his work for input or storage in an information system." (p. 25).

RC Pt. 6 states that, "It seems clear . . . that the actual copying of entire works (or substantial portions of them) for 'input' or storage in a computer would constitute a 'reproduction' under clause (1), whatever form the 'copies' take: punchcards, punched or magnetic tape, electronic storage units, etc." (p. 18).

Proponents of the input restriction argue that: (1) because of the potential for duplication and display, computers have the potential to destroy or damage the hard-copy market of authors and publishers; and (2) the publisher may want to market his product in machine-language form, and an unrestricted privilege of conversion to machine-language form would reduce his market.

Opponents of input control argue that the copyright owner is not damaged by input alone, and that the controls should be placed on the subsequent printing or distribution of copies. They argue that if it is not a violation of law for a student to look through a series of articles to find ones that are relevant, why should it be a violation for a computer to do this? Proponents of input control reply that it is not "the looking through" the copyrighted material that concerns them, but the possibility inherent in the computer of unlimited multiplication of copies at an unlimited number of locations which would seriously impair the publisher's economic ability to publish.

The bill also excludes machine-language storage for archival purposes. Section 108 says that it is not an infringement for a nonprofit institution with archival custody of unpublished works to reproduce them "in facsimile copies" for purposes of presentation or security. But HR.83 says that, ". . . a repository could make photocopies . . . by microfilm or electrostatic process, but could not reproduce the work in 'machine-readable' language for storage in an information system." (p. 37).

This has an impact on both the user and the manufacturer. Advances in digital image storage may make it possible for future systems to store and process images in digital form (in a manner similar to the now familiar pictures transmitted from the moon). The digital data could be stored in a number of ways (e.g., optically on film, or magnetically on a magnetic medium). Such digital storage means would be of value to the archivist. The images could also be stored in a video form, but video storage and retrieval systems are not exempt under the proposed language. The exclusion of a machine-language form may also cause difficulty for the archivist who wishes to use computer techniques for further operations to help him organize and use a collection (e.g., file searching on a manuscript text, machine indexing, concordance construction, literary criticism, and tests of authorship).

Input control may also have a large impact on people concerned with the computer processing of text material. As examples:

A. Organizations currently running a computerized Selective Dissemination of Information (SDI) system in which journal titles, abstracts or text are compared with a list of keywords or other indicators that characterize the subject interests of a staff member. There are an estimated 40 to 50 such systems in operation today in this country, some of them serving as many as 1000 users.

B. Organizations currently using computers to process or scan text material. Examples of this use are: file searching of text; automatic indexing or abstracting; machine translation; concordance or work list construction. Unless permitted by fair use, the preparation of such material might constitute a derivative work.

C. Organizations storing text in computers for use with display equipment. Examples of this use are on-line display of requested items and computer-assisted instruction.

It is, of course, true that the potential user can obtain the necessary permissions and licensing from the copyright holders. Commercial publishers have become accustomed to the handling of such requests, and some of them currently process several thousand requests per year as part of their normal business activity. Therefore, it may not be too difficult or time consuming for the user to obtain the necessary release from many of the major publishers. Furthermore, it is quite possible that the major publishers would be willing to make blanket approvals for more kinds of experimental work by researchers.

4. The Question of On-demand Distributing Libraries

In contrast to the practices of circulating or lending requested material to library users, a number of organizations and individuals have proposed a practice of making and furnishing expendable copies for distribution, with no copies to be returned to the libraries. From a technological viewpoint, it is possible and practical to do this under certain circumstances. Several publishers are already working in this manner, and many libraries and information centers have assumed this mode of operation for the majority of their inter-library loan traffic. The National Library of Medicine in 1959, for example, distributed approximately 75,000 copies of articles requested by other libraries. The ERIC information centers supported by the U.S. Office of Education expect to distribute thousands of copies of articles per year to interested users. Large distribution centers have been planned by other organizations. This copying of individual articles has grown to a considerable volume, and will probably continue to grow. Many professional societies, and publishers in some cases, have generally recognized the usefulness of copying techniques to scientists, and have endeavored to develop this type of usage for the mutual benefit of all concerned. A 1962 study sponsored by the NSF reported that there were no indications at that time of any significant financial damage to publishers because of copying practices.*) One government spokesman was recently reported as saying that only 17 out of the top 100 journals requested by NLM (National Library of Medicine) loans were from profit-oriented publishers. However, that situation seems to be changing, and some publishers indicate that they see real evidence of loss of subscriptions (particularly where there are multiple subscriptions to the same organization): they feel that this is directly due to the practice of copying the material by the subscriber.

The applicability of the fair use provision is unclear. No specific exemption is given to educational organizations for hard copy as it is for certain displays and performances (section 110). HR.83 says that, ". . . the Committee does not favor special fair use provisions dealing with the problems of library photocopying . . .", and again that, "Any educational uses that are fair use today would be fair use under the bill." (pp. 37, 31). There have been some suggestions that the practical interpretation of fair use could be accomplished by some kind of regulatory commission.

The bill needs study insofar as it may affect the development of library file collections. With the present technology, an on-demand or distributing library is more practical if the main file exists in microfilm, video tape recording, or some form other than the original hard copy. This would permit significant economies to be achieved in the duplication, storage, and material handling processes. Except for the limited fair use provision, the present bill does not permit microform (e.g., microfilm, microfiche, video tape recording) copies to be made without permission of the copyright holder.

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*Survey of Copyrighted Material and Reproduction Practices in Scientific and Technical Fields, George Fry and Associates, Chicago, 1962.

Mechanized equipment is available now (e.g., IBM Cypress, Ampex Videofile, Magnavox Magnavue) which can store the entire contents of a library in microform, and provide microform or viewing copies on demand. Some libraries in the future may become interested in replacing their copyrighted journals, books, proceedings, etc., with an equivalent microform for the machine file.

One solution may be to obtain the microform from the present licensed distributors (e.g., subscriptions are available to the microfilm editions of the New York Times and Chemical Abstracts). However, much of the library material may not be available in microform. HR.83 says, "A key, though not necessarily determinative, factor in fair use is whether or not the work is available to the potential user. If the work is 'out of print' and unavailable for purchase through normal channels, the user may have more justification for reproducing it than in the ordinary case, but the existence of organizations licensed to provide photocopies of out-of-print works at reasonable cost is a factor to be considered." (p. 34).

To summarize, existing copyright restrictions might make it difficult to convert library collections into forms other than the original hard copy, or to implement an on-demand distributing library. It would affect the present and planned operation of many information services. Suitable means should be provided to accomplish these goals.

5. The Question of Computer-Assisted Instruction Systems

Computer-Assisted Instruction (CAI) is the name given to the type of system in which a computer program is written to permit a student-machine instructional dialogue to take place. These programs may concentrate on a particular subject field (e.g., freshman courses in psychology or American history, fourth grade arithmetic or spelling courses). Over 20 different programs have already been developed. The systems typically work with some form of display device, such as a typewriter or cathode ray tube terminal, and some mechanism that permits the student to enter information into the computer from the terminal. Usually, the programs display some body of text or information for the user to read, then present a series of questions for the student to answer. A program includes appropriate responses to all possible answers, and leads the student through a sequence of correction and tutorial statements before re-testing. The student has finished the course when he has successfully passed through all of the quizzes. CAI may constitute the entire instruction of the course, or it may be used as an exercise to augment teaching by conventional means. A considerable amount of effort is required in the present CAI systems to plan the sequence of instruction, develop the tests and dialogue, and write the program.

CAI systems are currently being developed at more than 20 institutions across the country, and are being used on an experimental basis in classroom work in several schools. The University of California at Irvine, for example, is using over 14 terminals for the instruction of pupils in 24 different classes, for a total of 1500 terminal hours per month. Grades 3 to 6 in Brentwood Public School in Palo Alto, California, are using CAI techniques developed at Stanford University to help teach mathematics and English, with the aid of 8 teletype terminals from a computer system in another part of town. Each student uses a terminal once per day for 5 to 10 minutes. The same computer system is also being planned for experimental use with classes on the East Coast. In another experimental situation, some students at Harvard have been taking computer-assisted courses with a terminal linked to a computer 3000 miles away in Santa Barbara, California. In one of the most extensive installations, New York City will be starting a system in early 1968 with 196 terminals in 15 schools, grades 2 through 6, for arithmetic drill and practice, and later for spelling and reading. Similar development work is being done at the University of Illinois, Pennsylvania State University, University of Pittsburgh, University of Michigan, University of Texas, Florida State University, and University of California at Santa Barbara.

Various types of material may be displayed in a CAI system. It appears that few, if any, of the CAI programs used to date have incorporated any copyrighted or previously published material. The programs are generally developed anew, for each subject and installation, by the individual who is preparing the course. Thus there does not seem to be a significant problem yet in requiring clearance to use copyrighted material for these systems. However, this picture may change, especially if an institution with a CAI system wishes to incorporate previously published workbooks or portions of standard texts into its system, using one copy where it might otherwise have bought several hundred. This could be accomplished by arrangements between educational publishers and computer manufacturers, such as evidenced by the acquisitions of Science Research Associates and Random House by IBM and RCA, respectively, and by recent agreements whereby the computer manufacturers would use the programs developed by other publishers.

Section 110-(2) permits ". . . display of a work by or in the course of transmission by a governmental body or other non-profit organization, if: (A) the . . . display is a regular part of the systematic instructional activities of . . . a nonprofit educational institution; and (B) the radius of the area normally encompassed by the transmission is no more than 100 miles; and (C) the transmission is made primarily for: (i) reception in classrooms or similar places normally devoted to instruction . . . ; and (D) the time and content of the transmission are controlled by the transmitting organization and do not depend on a choice of individual recipients in activating transmission from an information storage and retrieval system or any similar device, machine, or process;. . . ."

HR.83 says that, "The transmission must not cover a radius of more than 100 miles, . . . and its time and content must be controlled by the transmitting organization, thus excluding transmissions of instructional material to individual users by means of computers and the like." (p. 5).

Most CAI systems would not be exempted under the bill because the student is the one who initiates the transmission and display by his choice. In addition, the 100-mile limit may constitute a difficulty.

In the bill, several conditions have been imposed on exempt displays of copyrighted material in order to protect the copyright owner from widespread on-demand use of a single copy of his material. Some observers argue that CAI systems will be handicapped by the lack of an educational exemption.

On the other hand, the general provisions of the bill would permit the actual CAI programs, text, and dialogue material to be copyrighted as a protection to the authors or developers. In the years to come, the development of a CAI program will be analogous to today's effort by the course instructor to develop a text for his course. He will probably have an interest in obtaining the corresponding royalties and recognition for his effort. Under the bill, organizations that are developing their own CAI programs and text will be able to use them without restrictions as to distance, mode and timing of transmission, volume or type of output, or number of users. Furthermore, they will be able to copyright these programs for their own benefit. This appears to be an important point with the developers of the programs who argue that a considerable amount of money may be invested in a program (reportedly over $400,000 for one of the major CAI programs), and that the developer must have some protection and incentive. They argue, further, that without copyright protection, the independent developer or publisher would have no incentive, and the field would be left to the equipment manufacturers and the government; this would not provide the diversity of instructional materials that the schools require.

Thus, we see a vagueness of objectives, and some sharp differences within the educational field regarding the needs of CAI and the merits of the proposed bill with regard to CAI.

6. The Question of Computer Preparation of Derivative Works

Computers are able to prepare many types of derivative works that would be possible, but relatively difficult, to prepare manually. Consequently the machines may be used more and more extensively for this task. A question is raised whether the bill does not place conditions on the preparation of derivative works that may make it difficult to exploit the full machine capability.

Section 101 says that, "A 'derivative work' is a work based upon one or more pre-existing works, such as a translation, musical arrangement, dramatization, fictionalization, motion picture version, sound recording, art reproduction, abridgment, condensation, or any other form in which a work may be recast, transformed, or adapted. A work consisting of editorial revisions, annotation, elaborations, or other modifications which, as a whole, represent an original work of authorship, is a 'derivative work'." Section 106 provides that the owner of copyright has the exclusive right "to prepare derivative works based upon the copyrighted work."

Examples of secondary works which can now, or may in the future, be prepared with computers are: translations or transliterations; concordances, indexes or catalogs; abstracts or extracts, statistical summaries. Whether, or to what extent, the several kinds of secondary works should be given legal status as derivative works with the consequence of vesting extensive control in the owner of the primary work, is a basic and difficult question in itself.

Since the early 1960's, major concordances have been prepared by computer processing of the full natural text, instead of being prepared manually. This will surely continue to be the case in the future. Computer techniques have also been used to prepare indexes to individual journals, as well as to entire collections of journals for a given subject field. Most of the major indexing and abstracting services (e.g., Chemical Abstracts, Index Medicus, Biological Abstracts) already use computer programs to construct some of the indexes to the articles they cover.

It is possible that the bill would be interpreted in such a way that organizations interested in using machine techniques to develop derivative works as research tools for local or widespread use would be prevented from doing so without permission of the copyright holder. A literary scholar, for example, who wanted to compile a detailed index or concordance to the writing of Hemingway, would be unable to do so without permission unless covered by the doctrine of fair use. The restriction on conversion to machine-language would apply, even if there were no restrictions on derivative works. However, the requirement that a researcher get permission from the copyright holder for the preparation of concordances, indexes, etc., does not seem to be an undue hindrance.

As a second example, an organization interested in scanning copyrighted printed matter (e.g., technical journals and articles) with a page reader in order to use a computer to prepare a brief abstract or detailed index, either for local or widespread use, might be unable to do so without permission.

Derivatives from derivatives pose some interesting questions. Would it be possible for an individual to take a magnetic tape corresponding to all of the citations of Chemical Abstracts, and extract a specific subsection to make a separate publication, such as Abstracts of Soviet Chemistry, without restrictions? How is this different from performing literature searches (for personal use or for profit) using Chemical Abstracts? Is it permissible to prepare an index to footnote citations (as done in the present citation indexes) without permission of the original authors? Should the author have the exclusive right to prepare indexes or concordances to his own books—but, in the public interest might he be required to let others do it if he does not do it within some specified time-period after publication?

Is it permissible to translate a program written in ALGOL programming language into a FORTRAN program without permission? Is it permissible to prepare a detailed flow chart for another person's program without permission? Is a programming language a language?

7. The Question of Property Rights in the Results of Computer Programs

We have already discussed the question of copyright in computer programs, but what rights should be allowed in the results of the use of a program? For example, computer programs have been written which compose music (there are some copyrighted works from an Illiac Computer program) and write poetry (published in early 1960's), given some initial data and starting conditions. Would all the future output of a program fall within the ownership of the holder of the program copyright?

As a second example, computer programs are now being used in some movie studios to compute and draw intermediate cartoon frames in a cartoon film sequence by interpolating between two given cartoon frames that are closely related. That is, an artist manually draws every-other-frame of the cartoon, but the computer program is used for smoothing and interpolation to generate the frames between the manually-drawn frames. Does the holder of the program copyright also have a share of the ownership of the cartoons? A similar situation might arise with computer programs used to generate patterns and designs for tapestries, garments, and other furnishings.

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